CLAIMS

1. A method of producing a photovoltaic device comprising the steps of: (1) providing a plurality of substantially spherical photovoltaic elements, each comprising a spherical first conductivity-type semiconductor and a second conductivity-type semiconductor layer covering the surface of the first conductivity-type semiconductor, the second conductivity-type semiconductor layer having an opening through which a part of the first conductivity-type semiconductor is exposed; (2) forming a first electrode on the exposed part of the first conductivity-type semiconductor of the photovoltaic element; (3) forming a second electrode on a part of the surface of the second conductivity-type semiconductor layer of the photovoltaic element; (4) providing a support having a plurality of recesses which are arranged adjacent to one another, each of the recesses having a connection hole in its bottom and receiving each of the photovoltaic elements, the support comprising an electric insulator layer having the connection holes and a second conductor layer which is formed on the electric insulator layer except around the connection holes and which constitutes the inner surface of the recesses; (5) disposing the photovoltaic element in the recess of the support such that the opening of the second conductivity-type semiconductor layer and a peripheral part of the exposed part of the first conductivity-type semiconductor are in contact with the

electric insulator layer around the connection hole; (6) electrically connecting the second electrode to the second conductor layer; and (7) electrically connecting the first electrode to a first conductor layer disposed on the backside of the support through the connection hole.

2. The method of producing a photovoltaic device in accordance with claim 1, wherein the first conductivity-type semiconductor and the second conductivity-type semiconductor layer are composed mainly of silicon.

3. The method of producing a photovoltaic device in accordance with claim 1, wherein the step (2) comprises applying a conductive ink onto the exposed part of the first conductivity-type semiconductor and subjecting it to a heat treatment.

4. The method of producing a photovoltaic device in accordance with claim 3, wherein the conductive ink comprises glass frit and at least one selected from the group consisting of silver, aluminum, tin, nickel, copper, phosphorus and phosphorus compounds, and the temperature range of the heat treatment is 500 to 750 ℃.

5. The method of producing a photovoltaic device in accordance with claim 1, wherein the step (3) comprises applying a conductive ink onto a part of the surface of the second conductivity-type semiconductor layer and subjecting it to a heat treatment.

6. The method of producing a photovoltaic device in

accordance with claim 5, wherein the conductive ink comprises glass frit and at least one selected from the group consisting of silver, aluminum, tin, nickel, copper, phosphorus and phosphorus compounds, and the temperature range of the heat treatment is 500 to 750 ℃.

7. The method of producing a photovoltaic device in accordance with claim 1, wherein the second electrode comprises a portion electrically connected to an external terminal and a portion collecting electric current from the second conductivity-type semiconductor layer, and these portions are in contact with each other.

8. The method of producing a photovoltaic device in accordance with claim 1, wherein the step (5) comprises bonding with an adhesive or melt-welding the opening of the second conductivity-type semiconductor layer and the peripheral part of the exposed part of the first conductivity-type semiconductor to the electric insulator layer around the connection hole.

9. The method of producing a photovoltaic device in accordance with claim 8, wherein the surface of the electric insulator layer is made of a thermoplastic resin at least around the connection hole.

10. The method of producing a photovoltaic device in accordance with claim 8, wherein the surface of the electric insulator layer is coated with a hot-melt adhesive or a pressure-sensitive adhesive at least around the connection

hole.

11. The method of producing a photovoltaic device in accordance with claim 1, wherein at least one of the steps (6) and (7) comprises connecting the electrode to the conductor layer with solder or conductive material.

12. The method of producing a photovoltaic device in accordance with claim 11, wherein the solder is spherical solder or palletized solder.

13. The method of producing a photovoltaic device in accordance with claim 11, further comprising preliminarily applying solder onto the surface of at least a part of the conductor layer to be soldered to the electrode prior to connecting the electrode to the conductor layer with solder.

14. The method of producing a photovoltaic device in accordance with claim 13, wherein the preliminarily applying solder comprises applying solder paste onto the surface of the conductor layer.

15. A method of producing a photovoltaic element comprising the steps of: (1) providing a plurality of substantially spherical photovoltaic elements, each comprising a spherical first conductivity-type semiconductor and a second conductivity-type semiconductor layer covering the surface of the first conductivity-type semiconductor, the second conductivity-type semiconductor layer having an opening through which a part of the first conductivity-type semiconductor is exposed; (2) forming a first electrode on the

exposed part of the first conductivity-type semiconductor of the photovoltaic element; (3) forming a second electrode on a part of the surface of the second conductivity-type semiconductor layer of the photovoltaic element; (4) providing a support having a plurality of recesses which are arranged adjacent to one another, each of the recesses having a connection hole in its bottom and receiving each of the photovoltaic elements, the support comprising an electric insulator layer having the connection holes and a second conductor layer which is formed on the electric insulator layer except around the connection holes and which constitutes the inner surface of the recesses; (5) bonding with an adhesive or melt-welding the opening of the second conductivity-type semiconductor layer and the peripheral part of the exposed part of the first conductivity-type semiconductor to the electric insulator layer around the connection hole to fix the photovoltaic element into the recess of the support; (6) connecting the second electrode to the second conductor layer with solder or conductive material; and (7) connecting the first electrode to a first conductor layer disposed on the backside of the support through the connection hole with solder or conductive material,

wherein the steps (5), (6) and (7) are performed simultaneously by pressing, while heating, the photovoltaic element, with solder or a conductive-material-containing paste placed between the second electrode and a part of the second

conductor layer to be connected to the second electrode and between the first electrode and a part of the first conductor layer to be connected to the first electrode.

16. A method of producing a photovoltaic element comprising the steps of: (1) providing a plurality of substantially spherical photovoltaic elements, each comprising a spherical first conductivity-type semiconductor and a second conductivity-type semiconductor layer covering the surface of the first conductivity-type semiconductor, the second conductivity-type semiconductor layer having an opening through which a part of the first conductivity-type semiconductor is exposed; (2) forming a first electrode on the exposed part of the first conductivity-type semiconductor of the photovoltaic element; (3) forming a second electrode on a part of the surface of the second conductivity-type semiconductor layer of the photovoltaic element; (4) providing a support having a plurality of recesses which are arranged adjacent to one another, each of the recesses having a connection hole in its bottom and receiving each of the photovoltaic elements, the support comprising an electric insulator layer having the connection holes and a second conductor layer which is formed on the electric insulator layer except around the connection holes and which constitutes the inner surface of the recesses; (5) bonding with an adhesive or melt-welding the opening of the second conductivity-type semiconductor layer and the peripheral part

of the exposed part of the first conductivity-type semiconductor to the electric insulator layer around the connection hole to fix the photovoltaic element into the recess of the support; (6) electrically connecting the second electrode to the second conductor layer; and (7) connecting the first electrode to a first conductor layer disposed on the backside of the support through the connection hole with solder,

wherein the steps (5) and (7) are performed simultaneously by pressing the photovoltaic element in such a direction as to bring the opening of the second conductivity-type semiconductor layer and the peripheral part of the exposed part of the first conductivity-type semiconductor in contact with the electric insulator layer around the connection hole, with solder placed between the first electrode and a part of the first conductor layer to be soldered to the first electrode, while heating the solder and the electric insulator layer.

17. A method of producing a photovoltaic element comprising the steps of: (1) providing a plurality of substantially spherical photovoltaic elements, each comprising a spherical first conductivity-type semiconductor and a second conductivity-type semiconductor layer covering the surface of the first conductivity-type semiconductor, the second conductivity-type semiconductor layer having an opening through which a part of the first conductivity-type

semiconductor is exposed; (2) forming a first electrode on the exposed part of the first conductivity-type semiconductor of the photovoltaic element; (3) forming a second electrode on a part of the surface of the second conductivity-type semiconductor layer of the photovoltaic element; (4) providing a support having a plurality of recesses which are arranged adjacent to one another, each of the recesses having a connection hole in its bottom and receiving each of the photovoltaic elements, the support comprising an electric insulator layer having the connection holes and a second conductor layer which is formed on the electric insulator layer except around the connection holes and which constitutes the inner surface of the recesses; (5) disposing the photovoltaic element in the recess of the support such that the opening of the second conductivity-type semiconductor layer and a peripheral part of the exposed part of the first conductivity-type semiconductor are in contact with the electric insulator layer around the connection hole; (6) connecting the second electrode to the second conductor layer with solder; and (7) connecting the first electrode to a first conductor layer disposed on the backside of the support through the connection hole with solder,

wherein the step (7) comprises placing a first solder between the first electrode and a part of the first conductor layer to be soldered to the first electrode and heating the first solder to solder the first electrode to the

first conductor layer and is performed before the step (6), and the step (6) comprises placing a second solder having a liquidus temperature lower than the solidus temperature of the first solder between the second conductor layer of the support and the second electrode of the photovoltaic element soldered to the first conductor layer by the step (7) and heating the second solder at a temperature lower than the solidus temperature of the first solder and not lower than the liquidus temperature of the second solder to solder the second electrode to the second conductor layer.

18. The method of producing a photovoltaic device in accordance with claim 17,

wherein the diameter of the photovoltaic element is 0.5 to 2.0 mm,

the first solder is one or more spherical solder particles, of which diameter is not greater than the diameter of the connection hole, not less than the depth of the connection hole and 0.1 to 0.5 mm, and

the second solder is a plurality of spherical solder particles, of which diameter is 0.03 to 0.1 mm.

19. The method of producing a photovoltaic device in accordance with claim 17, wherein the liquidus temperature of the first solder is 200 to 300 ℃, and the liquidus temperature of the second solder is 100 to 200 ℃.

20. The method of producing a photovoltaic device in accordance with claim 17, wherein the first solder contains

not less than 90% by weight of tin.

21. The method of producing a photovoltaic device in accordance with claim 17, wherein the second solder contains 40 to 60 % by weight of tin and a total of 60 to 40 % by weight of indium and bismuth.

22. A photovoltaic device comprising: a plurality of substantially spherical photovoltaic elements, each comprising a spherical first conductivity-type semiconductor and a second conductivity-type semiconductor layer covering the surface of the first conductivity-type semiconductor, the second conductivity-type semiconductor layer having an opening through which a part of the first conductivity-type semiconductor is exposed, a first electrode being formed on the exposed part of the first conductivity-type semiconductor, a second electrode being formed on a part of the surface of the second conductivity-type semiconductor layer; a support having a plurality of recesses which are arranged adjacent to one another, each of the recesses having a connection hole in its bottom and receiving each of the photovoltaic elements, the support comprising an electric insulator layer having the connection holes and a second conductor layer which is formed on the electric insulator layer except around the connection holes and which constitutes the inner surface of the recesses; and a first conductor layer disposed on the backside of the support,

wherein the second electrode of the photovoltaic

element disposed in the recess is electrically connected to the second conductor layer, and the first electrode is electrically connected to the first conductor layer through the connection hole.

23. The photovoltaic device in accordance with claim 22, wherein at least either the second electrode and the second conductor layer or the first electrode and the first conductor layer are connected to each other with solder or conductive material.

24. The photovoltaic device in accordance with claim 22, wherein the surface of the electric insulator layer around the connection hole has a shape corresponding to the shape of the peripheral part of the exposed part of the first conductivity-type semiconductor and the opening of the second conductivity-type semiconductor layer.